Stoller
Grand Junction Office established 1959

GJO-2003-534-TAC

C4194
Log Data Report

Borehole Information:

Borehole: C4194			**Site:** 216-B-26 Trench		
Coordinates (WA State Plane)		**GWL (ft)[1]:** Not reached		**GWL Date:**	11/13/2003
North	**East**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
n/a[3]	n/a	Nov. 2003	n/a	40	Percussion

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0	6 5/8	5 5/8	1/2	0	

The logging engineer used a caliper to determine the outside casing diameter. The caliper and inside casing diameter were measured using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated.

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe. The ground surface between 0 and about 1 ft is compacted gravel that was trucked in to stabilize the ground surface for drilling and logging operations.

Logging Equipment Information:

Logging System:	Gamma 2A	**Type:**	35% HPGe (34-TP20863A)
Calibration Date:	09/2002	**Calibration Reference:**	GJO-2002-383-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 2F	**Type:**	Moisture (H380932510)
Calibration Date:	09/2003	**Calibration Reference:**	GJO-2003-520-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2/Repeat			
Date	11/18/03	11/18/03			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	39.0	7.0			
Finish Depth (ft)	1.0	3.0			
Count Time (sec)	200	200			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			

Log Run	1	2/Repeat			
ft/min	N/A[4]	N/A			
Pre-Verification	BA220CAB	BA220CAB			
Start File	BA220000	BA220039			
Finish File	BA220038	BA220043			
Post-Verification	BA221CAA	BA221CAA			
Depth Return Error (in.)	0	0			
Comments	No fine-gain adjustment.	Repeat section.			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2/Repeat			
Date	11/14/03	11/14/03			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	10.0			
Finish Depth (ft)	39.5	14.0			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N/A	N/A			
MSA Interval (ft)	0.25	0.25			
ft/min	1.0	1.0			
Pre-Verification	BF114CAB	BF114CAB			
Start File	BF114000	BF114160			
Finish File	BF114159	BF114176			
Post-Verification	BF114CAA	BF114CAA			
Depth Return Error (in.)	N/A	0			
Comments	None	Repeat section.			

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe. Logging was performed with a centralizer installed on the sondes.

SGLS data were collected using Gamma 2A. Pre- and post-survey verification measurements employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 082.

Analysis Notes:

Analyst:	Sobczyk	Date:	11/24/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits. All of the verification spectra were within the acceptance criteria. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 2.0 percent lower and 5.0 percent higher at the end of the day. Examinations of spectra indicate that the sonde functioned normally during logging, and the spectra are accepted.

NMLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. The post-run verification spectrum was within

the control limits while the pre-run verification spectrum recorded 745 cps versus the upper control limit of 735 cps.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2AFeb03.xls). Zero reference was the ground surface. On the basis of measurements supplied by the driller, the casing configuration was assumed to be one string of 6-in. casing to total logging depth (39 ft). The casing correction factor was calculated using a 6-in. casing thickness of 0.5 in. This casing thickness is based upon the field measurement. Water and dead time corrections were not required.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. The neutron moisture calibration is based on a typical 6-in. casing with a thickness of 0.28 in., and the neutron moisture values were corrected for the 0.5-in. casing thickness.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and volume fraction of water, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected in the interval from 2 to 13 ft at concentrations ranging from the MDL (0.2 pCi/g) to 7.3 pCi/g. The maximum concentration of ^{137}Cs was measured at 11 ft.

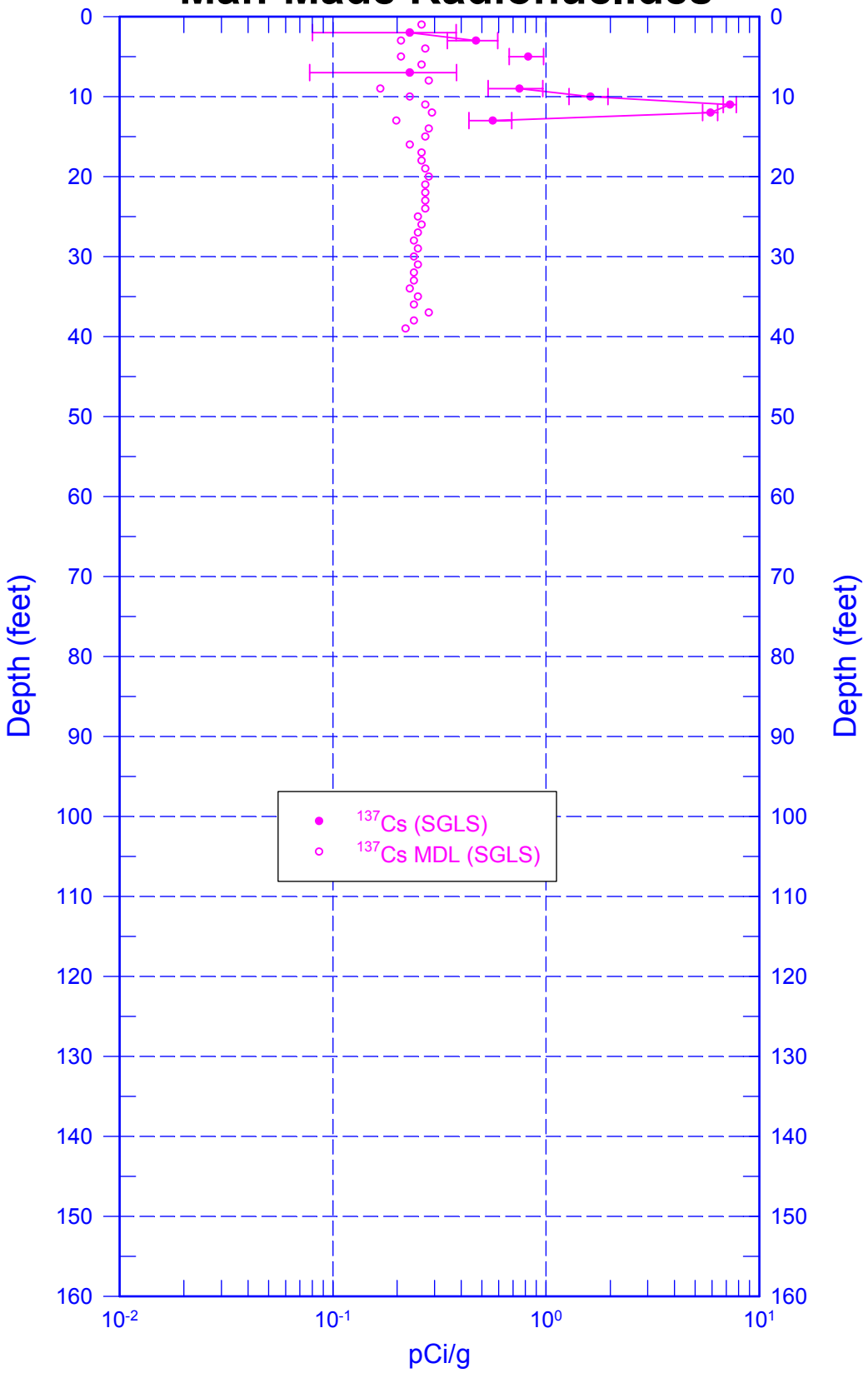
The plots of the repeat logs demonstrate reasonable repeatability of the SGLS and NMLS data. The natural radionuclides at energy levels of 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. Trace amounts of ^{137}Cs were detected at 4 ft and 6 ft on the repeat log run and not on the original log run. The original log run detected ^{137}Cs at 7 ft while the repeat log run did not detect ^{137}Cs at 7 ft. The neutron-moisture and its repeat are within the acceptance criteria.

---

[1] GWL – groundwater level
[2] TOC – top of casing
[3] n/a – not available
[4] N/A– not applicable

C4194

Man-Made Radionuclides

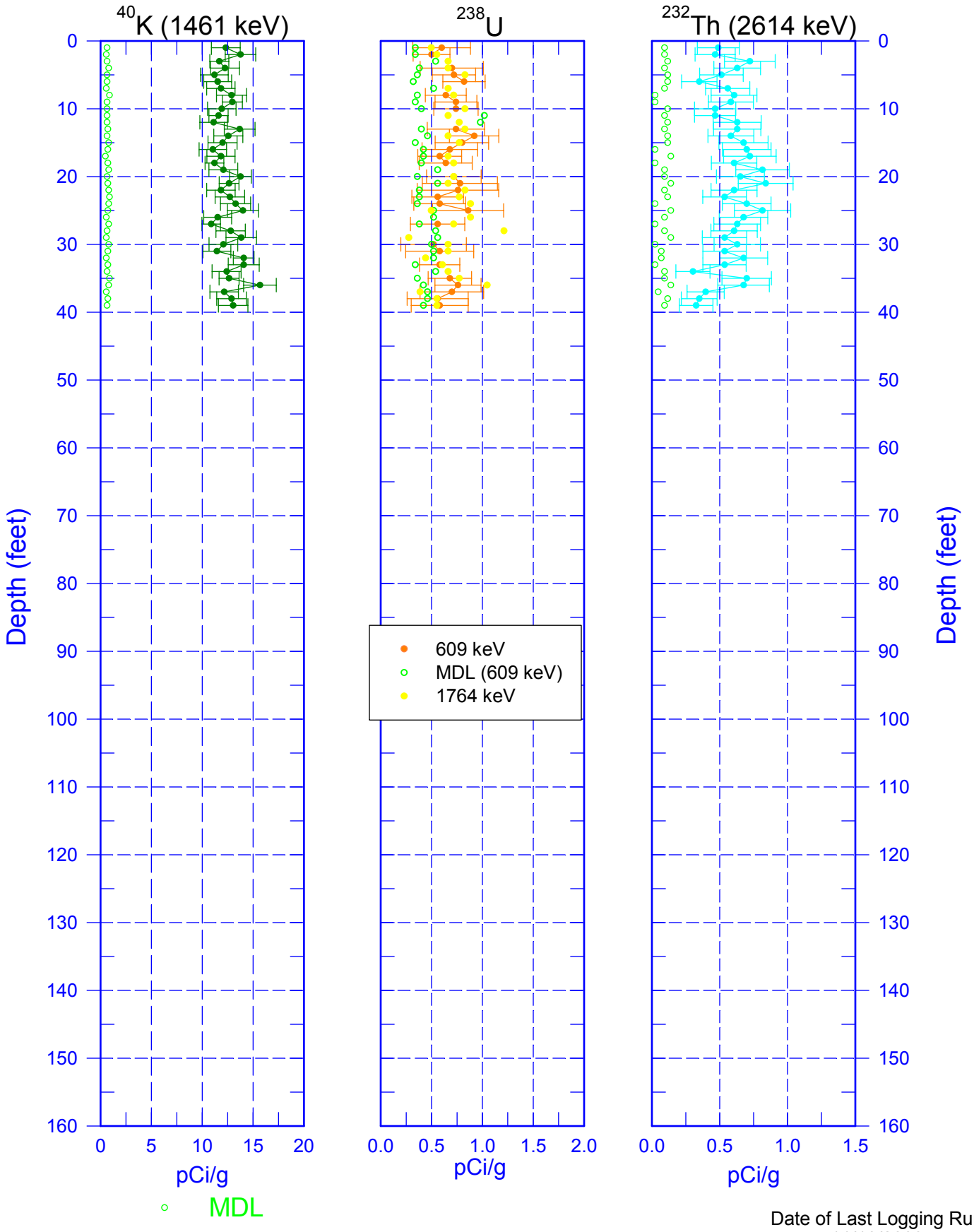


Zero Reference = Ground Surface

Date of Last Logging Run
11/18/2003

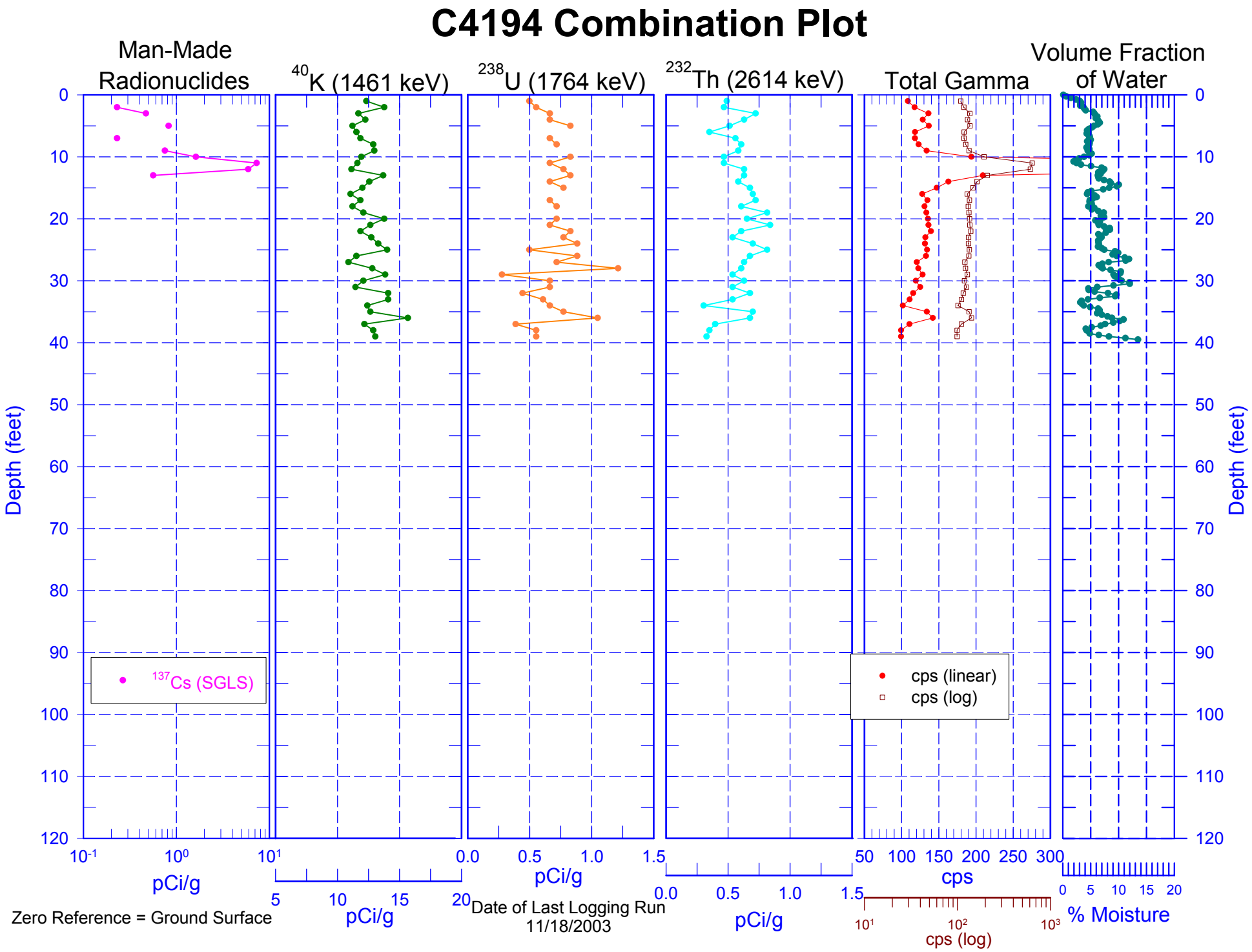
C4194

Natural Gamma Logs

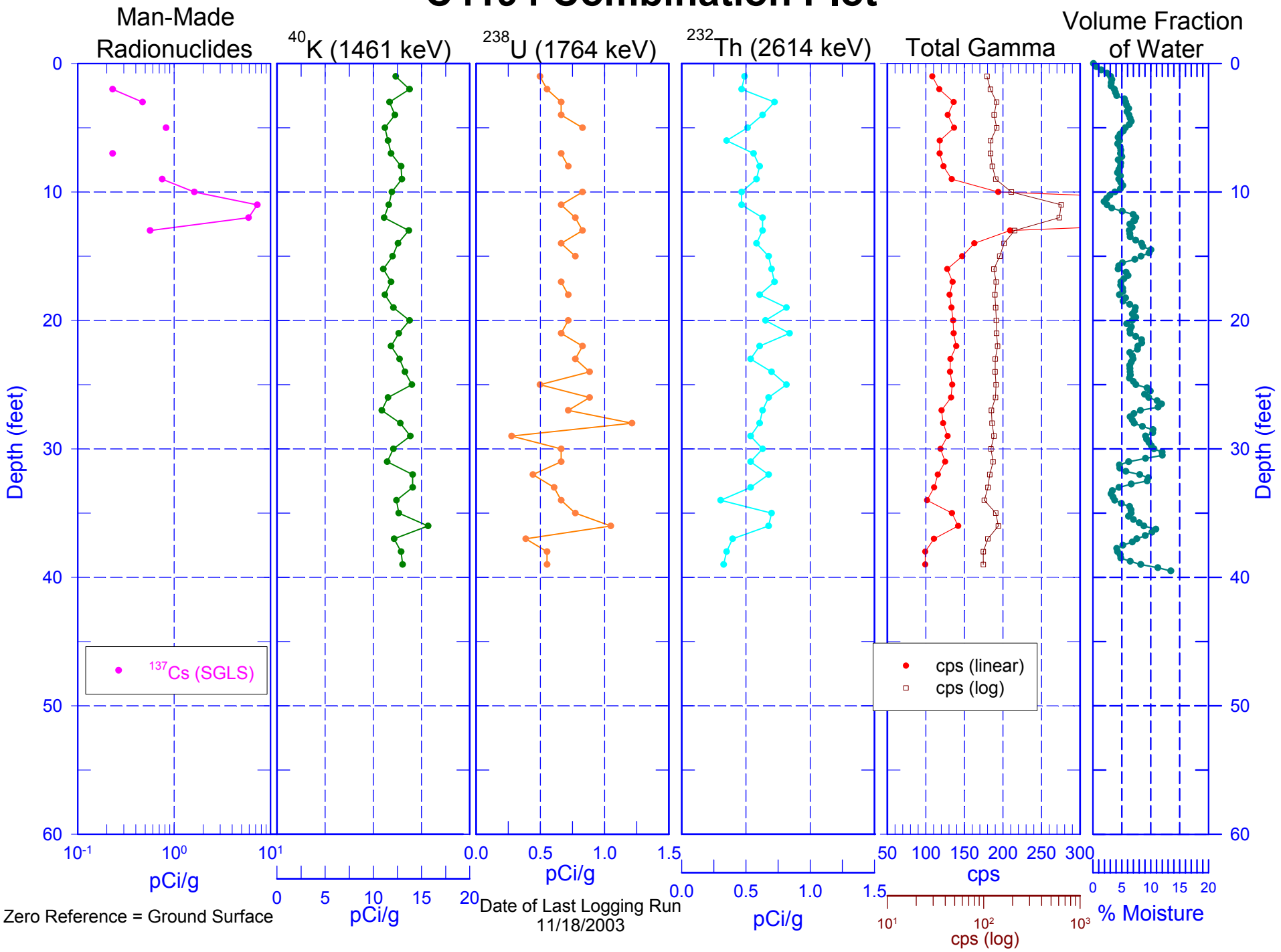


Zero Reference = Ground Surface

Date of Last Logging Run
11/18/2003

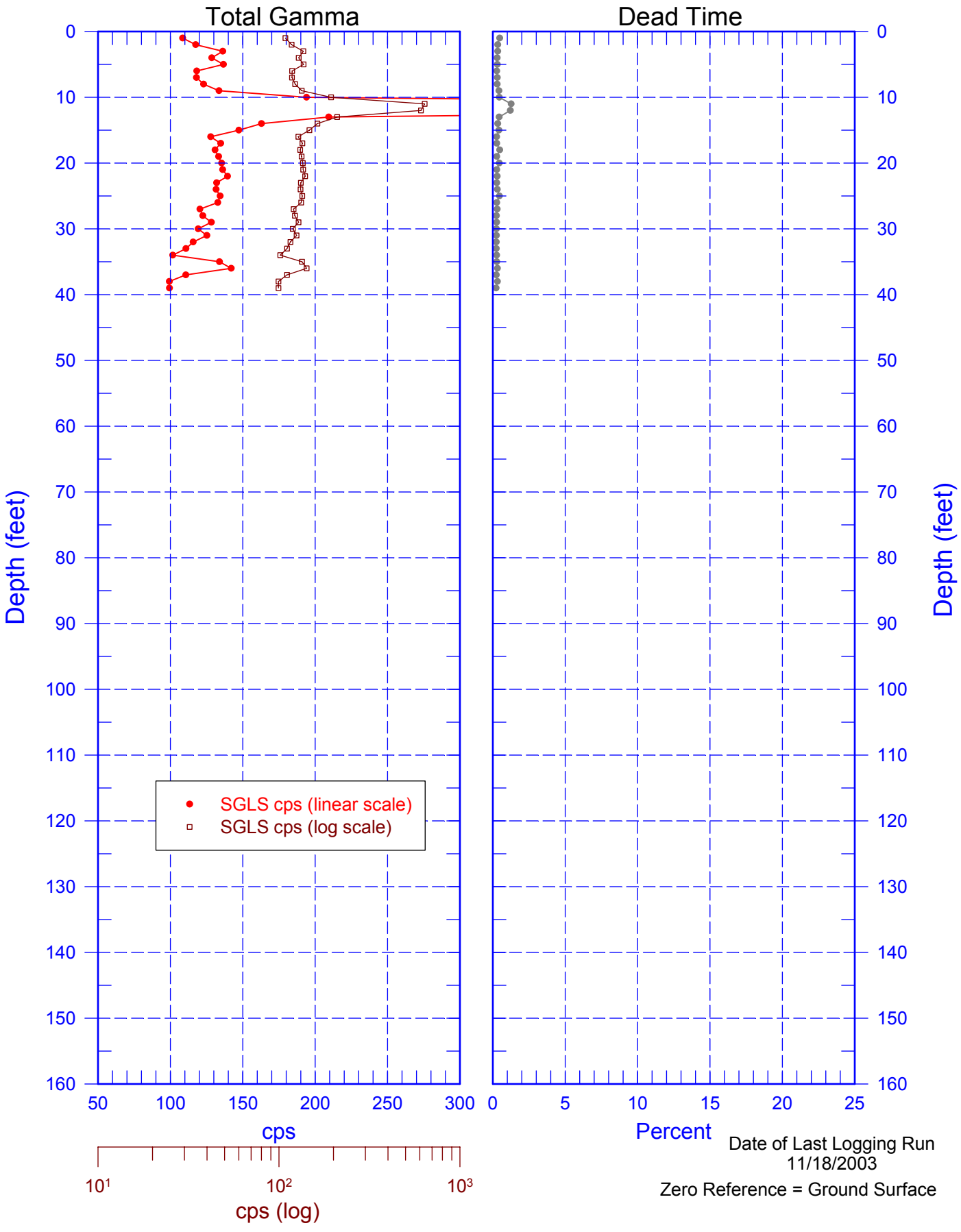

C4194 Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Volume Fraction of Water
Depth (feet)
137Cs (SGLS)
cps (linear)
cps (log)
pCi/g
cps
% Moisture
Zero Reference = Ground Surface
Date of Last Logging Run
11/18/2003

C4194 Combination Plot



C4194

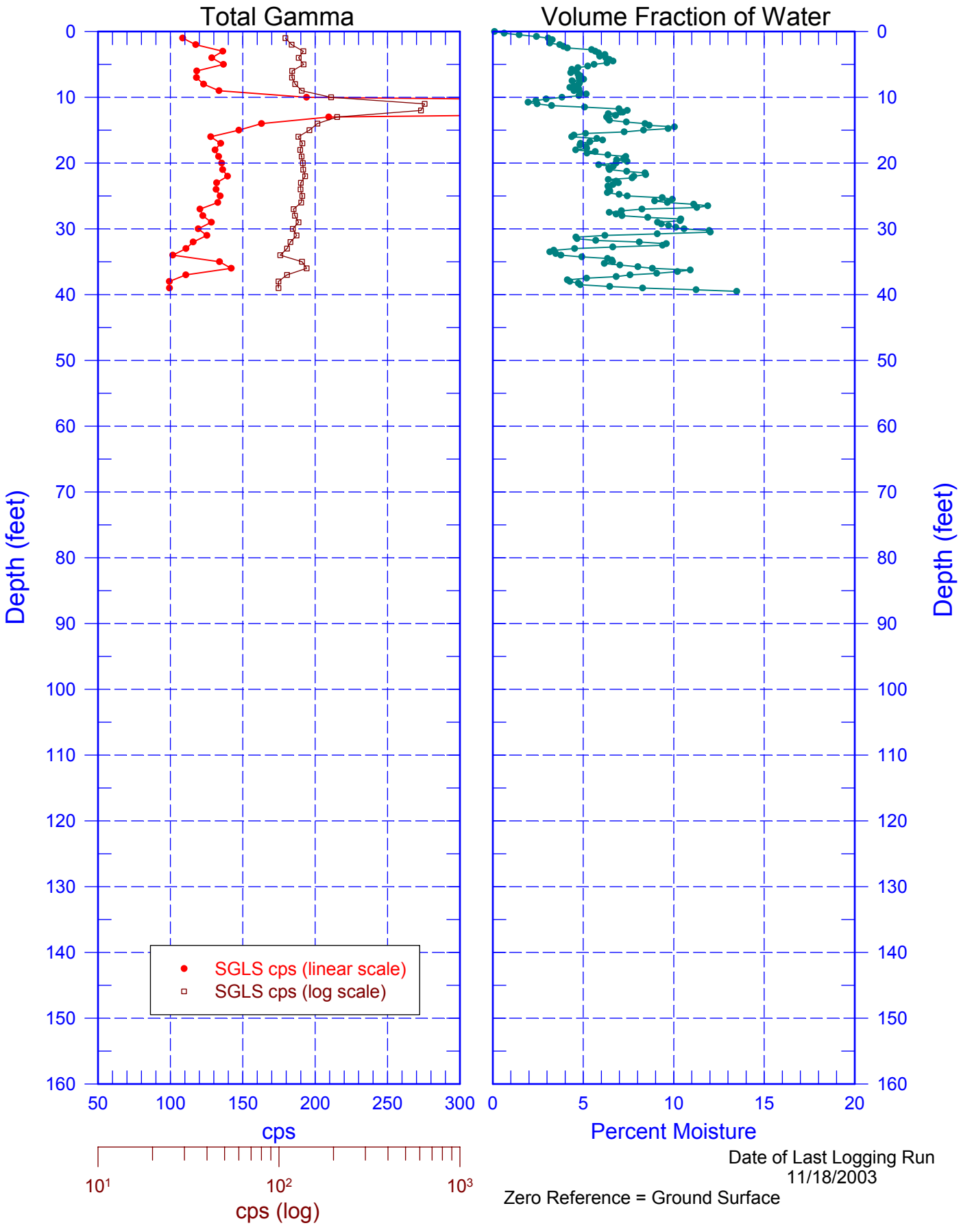
Total Gamma & Dead Time



Date of Last Logging Run
11/18/2003

Zero Reference = Ground Surface

C4194
Total Gamma & Neutron

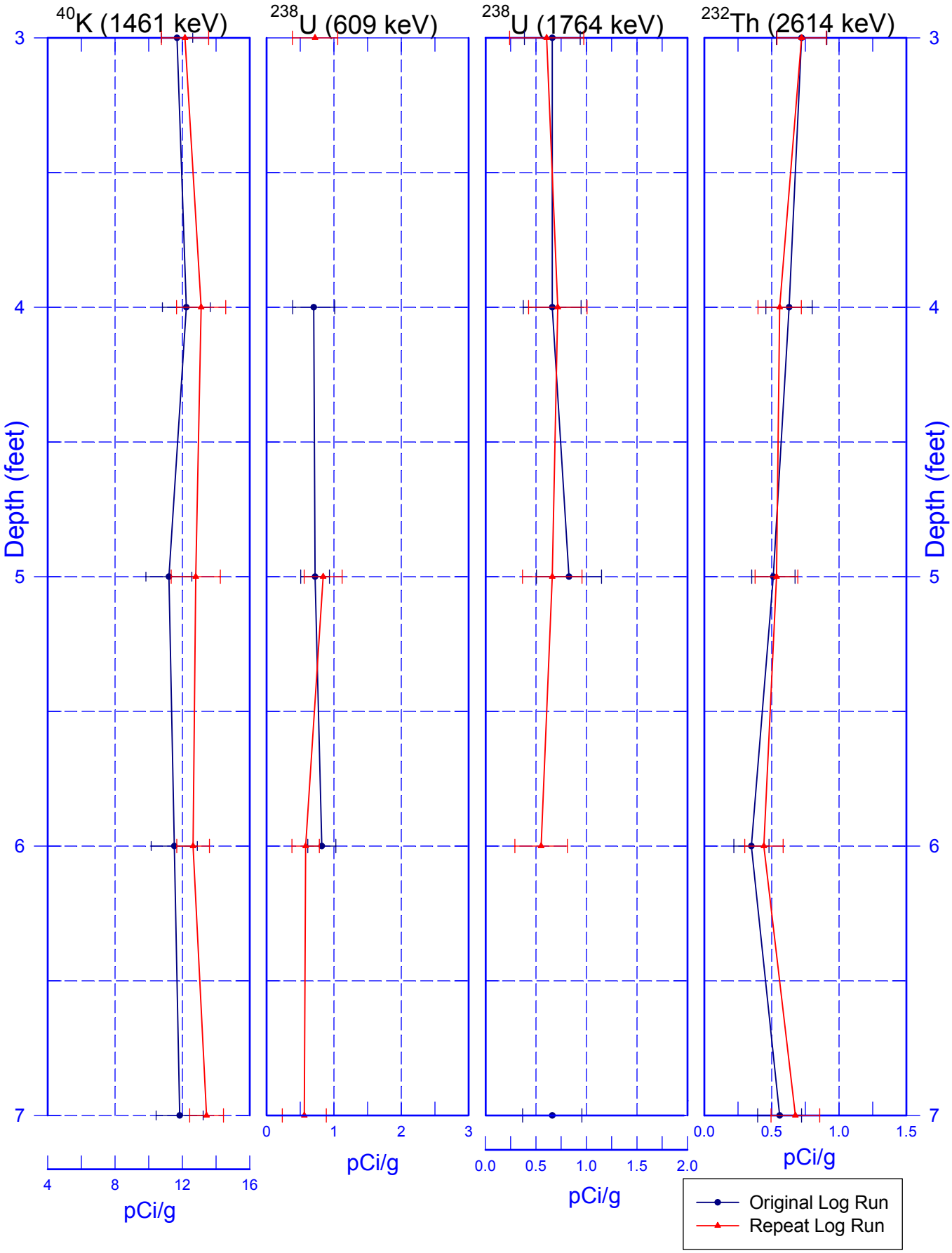


Date of Last Logging Run
11/18/2003

Zero Reference = Ground Surface

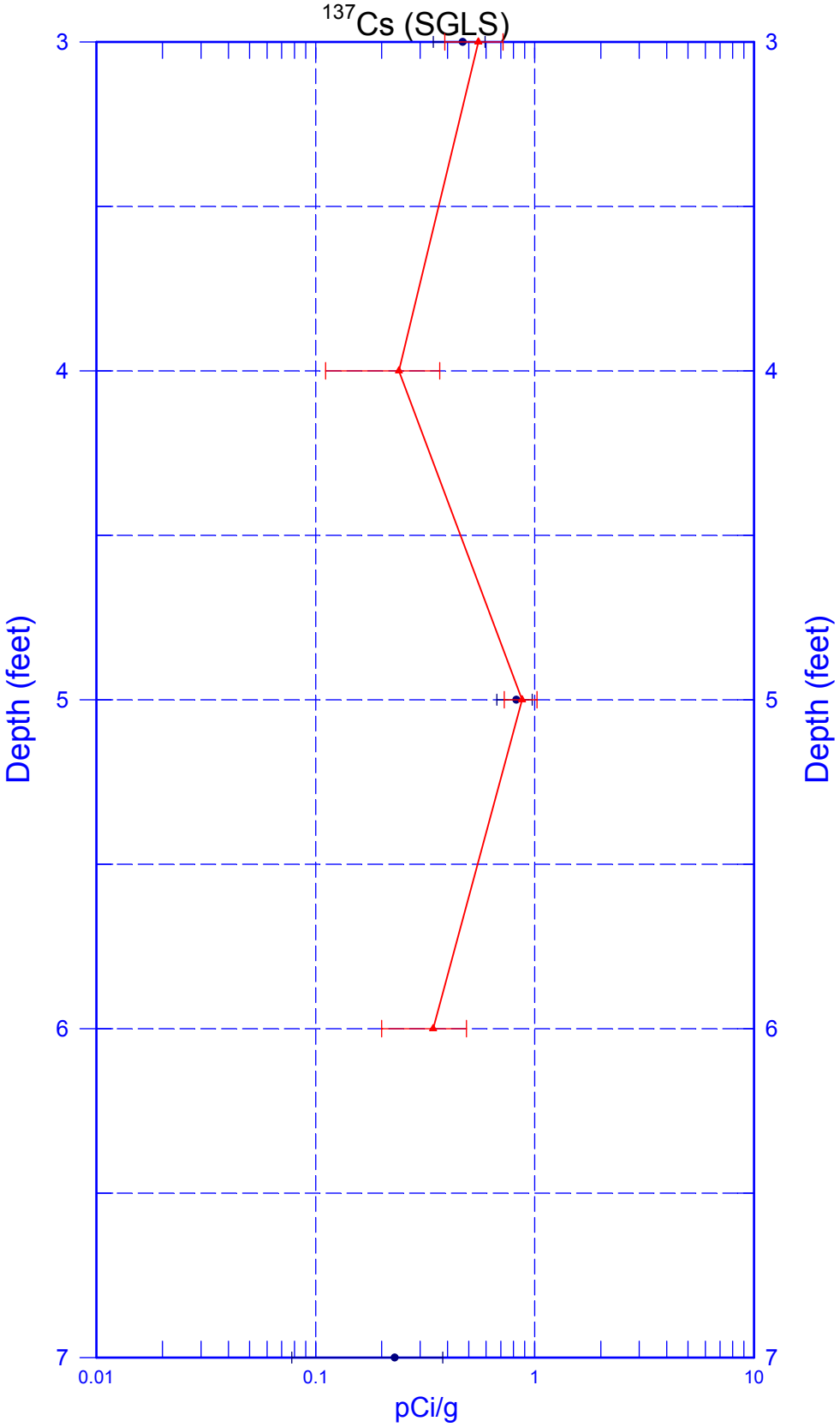
C4194

Rerun of Natural Gamma Logs (7.0 to 3.0 ft)



C4194

Rerun of Man-Made Radionuclides



C4194

Rerun of Neutron-Moisture Log (10.0 to 14.0 ft)

Volume Fraction of Water